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Research Article

Exploring the Efficacy of Medicinal Plants (*Moringa Oleifera* and *Tamarindus Indica* Seeds) in the Treatment of Well Water in Two Major Cities in Southwestern Part of Nigeria, West Africa

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Abstract

Water quality and treatment is becoming of great concern, especially in developing country like Nigeria where water quality is poor and not properly treated. It is in this light that this research was carried out to confirm the effectiveness of powdered extracted from matured dried *Moringa oleifera* seed which is commonly available in most rural communities in Nigeria and *Tamarindus indica* seed which is mostly available in the Northern part of Nigeria. The aim of this study is to determine the physiochemical properties, microbial load, and effectiveness of the natural coagulant (*Moringa oleifera* and *Tamarindus indica* seed extracts) on the collected water samples. Seed extracts were prepared and pour plate techniques was carried out to determine the microbial load before and after introduction of the seed extracts, colonial and biochemical characteristics were used in identification of the microbial isolates. Physicochemical properties of the water sample and secondary metabolites (phytochemical) constituents of the seed extracts were also determined. The pH of the water sample ranges from 6.0 to 7.7, the temperature ranges from 30 to 31°C and turbidity range from 4.6 NTU to 15 NTU for alum, 9.0 NTU to 18.6 NTU for *Tamarindus indica* and 5.3 NTU to 15 NTU for *Moringa oleifera*. The bacterial count of the water samples ranges from 0.02 x 10^2 to 0.75 x 10^2cfu/ml. The bacteria isolates were identified as *Bacillus pumilus, Klebsiella pneumonia, Enterobacter aerogenes, Alcaligenes faecalis, Pseudomonas alcaligenes, Azotobacter chroococcum, Paracoccus denitrificans, Leuconostoc mesenteriodes, Bacillus cereus, Bacillus subtilis, Staphylococcus aureus* and *Micrococcus luteus*. The results of this study showed that the application of *Moringa oleifera* and *Tamarindus indica* seeds as a coagulant improved water quality in terms of pH, turbidity and microbial load compared to the use of alum. However, *M. oleifera* was observed to be more effective in improving the water quality.

Keywords: *Moringa oleifera*; *Tamarindus Indica* Seeds

Introduction

Natural plant extracts have been used for water purification for many centuries and Egyptians inscription afforded the earliest recorded knowledge of plant materials used for water treatment, dating back perhaps to 2000BC in addition to boiling and filtration Fahey [1]. Traditionally, treatment of turbid water is carried out at household level using local materials of plant origin. For example, rural people who depend on muddy water from rivers or streams, natural rain ponds and artificial rain-water catchments for domestic water supply, treat water fetched from such sources using *Moringa* seeds and other plant *Moringa oleifera* is the most widely cultivated species of the monogeneric family *Moringaceae* (order Brassicales), that includes 13 species of trees and shrubs distributed in sub-Himalayan ranges of India, Sri Lanka, North Eastern and South Western Africa, Madagascar and Arabia. Today it has become naturalized in many locations in the tropics and is widely cultivated in Africa, Sri Lanka, Thailand, Burma, Singapore, West Indies, Sri Lanka, India, Mexico, Malabar, Malaysia and the Philippines [1]. Moringa oleifera is valued mainly for its tender pods, which taste as vegetable, all its parts: bark, root, fruit, flowers, leaves, seeds and even gum are of medicinal value. They are used in the treatment of

ascites, rheumatism, venomous bites and as cardiac and circulatory stimulants. Fresh root of the young tree (as also the root bark) is used internally as stimulant, diuretic and anti-lithic and externally applied as a plaster or poultice to inflammatory swellings [2]. Moringa leaves and fruit pods are rich sources of calcium and iron, good sources of vitamins A, B, & C and of protein including good amounts of the sulphur-containing amino acids, methionine and cystine. Both young and older leaves are edible, though older ones are milder and tender. They can be cooked in soups or boiled. Young pods may be also cooked. Immature seeds are often cooked and eaten as a fresh vegetable, while mature seeds can be dried and roasted. The flowers can be cooked or oven-dried and steeped as tea. Dried leaves can be stored as future soup or sauce supplements [3].

Tamarindus indica of the Fabaceae, sub-family *Caesalpinioideae*, is an important food in the tropics. Tamarind is a fruit with a characteristic sweet and sore taste used in various foods preparation around the world, this appetizing pod-like fruit is dietary powerhouse with a large quantity of health benefit. *Tamarindus indica* (Tamarind) plant grows up to 40-80 meters depending on soil condition and environment factors associated with the weather condition. Undercooked tamarind is fit for human consumption; it has an extraordinary sore taste. Full-grown tamarind pod or mature pods when cracked open have brownish-black colored fruit containing hard black seed [4]. Tamarind trees are cultivated in abundance in regions of Africa, Asia, and South America (Spice Board, 2011a). Aside from being in world cuisine, tamarind fruit is tremendously popular because of its perceived medicinal benefits [5]. It is a multipurpose tree of which almost every part finds at least some use either nutritional or medicinal [6]. *Tamarindus indica* (Tamarind) is indigenous to tropical Africa but it has been introduced and naturalized worldwide in over 50 countries. Tamarind (*Tamarindus indica*, Fabaceae), a tropical fruit found in Africa and Asia is highly valued for its pulp.

Tamarind fruit pulp has a sweet acidic taste due to a combination of high contents of tartaric acid and reducing sugars. However, Tamarind seed has been found to be effective in treating water [7]. In some African countries, the juice obtained from the fruit pulp is mixed with wood ash to neutralize the sour taste of the tartaric acid. However, the most common method is to add sugar to make a pleasantly acid drink. In Ghana, the pulp is mixed with sugar and honey to make a sweet drink. Most of the producing countries manufacture drinks commercially. Sometimes pulp is fermented into an alcoholic beverage [4]. Tamarind is used in herbal medicine in many parts of the world [8] and medicinal uses of tamarind are uncountable There is medical interest in the use of purified xyloglucan from tamarind in eye surgery for conjunctival cell adhesion and corneal wound healing [4]. Tamarind fruit is regarded as a digestive, carminative, laxative, expectorant and blood tonic, anti-hepatoxic, anti-inflammatory, anti-diabetic activities [9]. And combination with lime juice, honey, milk, dates fruit, spices or camphor, the pulp is considered to be effective as a remedy for biliousness and bile disorders, and as an antiscorbutic. In past years there has been considerable interest in the development of usage of natural coagulants which can be produced extracted from microorganisms, animal or plant tissues. These coagulants should be biodegradable and are presumed to be safe for human health.

Methods

Collection of water samples

Six well water samples were collected from AkokoOndo State. The water samples in Akoko were collected from Ugbe-Akoko, Ayegunle-Akoko, Oka-Akoko, Iwaro-Akoko, Ikare-Akoko and Akungba-Akoko, and six well water samples from Ado-Ekiti, Ekiti State. Each water samples were collected randomly from different locations in Ado Ekiti, from Moferere, Araromi, Ereguru, Oke-Oriomi, Oke-bola and Ajilosun. The seed of the plant Moringa oleifera was collected from Ibadan, Oyo State and Tamarindusindicaseed used as coagulant was collected from Kastina, Kastina State.

Sterilization of laboratory equipment

The materials used for this study including glass wares such as the Petri-dishes, pipette, test tubes, conical flasks and McCartney bottles were sterilized. The inoculating loop, wire loop was sterilized by flaming in Bunsen burner until red hot, the surface of the working bench was also sterilized by swabbing with antiseptic solution of 70% ethanol. The media used were sterilized in the autoclave at 121°C for 15min.

Preparation of media

The culture media (MacConkey agar (47g) and Nutrient agar (28g)) used were prepared according to the manufacturer's instructions. The media were suspended in appropriate amount of distilled water and plugged with cotton wool and subsequently covered with aluminum foil and homogenized using heating mantle and then autoclaved at 121°C for 15min.

Pour plate techniques

Serial dilution of the water sample was carried out before plating using the methods of [10]. Using a sterile syringe, 9mls each of the sterile water was placed into 4 different test-tubes arranged in a test tubes rack. The water sample was agitated to mix, then 1 ml of the sample was taken and then added into the first test tube in the rack to make dilution 1 and shaken properly. 1 ml of dilution 1 was taken and added into the second test tube to make dilution 2 and mixed. This process was repeated for the 4-test tubes.

Isolation of bacterial isolates

1 ml of each dilution 2 and 4 was drawn into the Petri-dish labeled accordingly after which the already prepared cooled MacConkey agar was poured into the plate, it was gently swirl and

allowed to solidify. The plates were inverted and incubated at 37°C for 24 hours. After the incubation period, number of colony growth on the agar were counted and recorded as cfu/ml.

Sub-culturing of isolates

Pure isolates were sub-cultured on prepared nutrient agar slants in McCartney bottles at 37 ℃ overnight and refrigerated at 4°C for further analysis.

Morphological characterization of the isolates

The isolates were subjected to cultural, morphological and biochemical tests. Gram staining, motility test, sugar fermentation test (Glucose, Galactose, fructose, lactose, sucrose, xylose, mannitol, maltose and dextrose), catalase test, indole test, methyl red test, citrate utilization test, starch hydrolysis and voges proskaeur test were carried out.

Cultural characterization of isolates

The different shapes, color, elevation, edge, surface of the isolates was observed on plate to distinguish the bacteria isolates.

Gram staining

This test shows the ability of a bacteria cell to retain or lose the color of basic dye, crystal violet or safranin. A heat fixed smear of each bacteria isolates was made on a clean, grease- free, labelled slide. The smear was stained with crystal violet solution for 60s and rinsed with water. The smear was then flooded with iodine for 60s and rinsed with water. After this, it was decolorized with 95% ethanol for 30s and rinsed with water. It was counterstained with 2 drops of safranin solution for 60s. Then the slide was rinsed with water, blotted dry and examined under microscope using oil immersion objective lens (x100). The bacteria cells that retained the crystal violet purple color was indicated as Gram positive organisms and those that retained the Safran in pink color are indicated as Gram negative organisms.

Biochemical characteristics of isolates

Catalase test: This test shows the ability of the organisms to produce catalase. A drop of hydrogen peroxide was placed on a glass slide and a colony of the isolated organism was emulsified to the slide using inoculating loop and then mixed with hydrogen peroxide on the slide. The production of catalase enzyme was detected by the production of bubbles indicated positive result and absence of bubble indicated negative results [11].

Oxidase test: The test was done to detect the presence of cytochrome C and hence the production of oxidase enzyme. Oxidase paper strip was used to test for the oxidase reaction, the strip was simply placed in a drop of sterile water and then was rubbed on the isolates. The appearance of purple color within 30s indicated a positive result and without purple color indicated a negative result.

Methyl Red test: This was done to detect the production of enough acid during the fermentation of glucose. Pure cultures of the microorganisms were inoculated into different tubes containing MR-VP broth and were incubated at 37℃ for 48h. Five drops of methyl red indicator solution was added to each tube. A positive result was indicated by a change in color from yellow to red.

Voges proskauer test

This test was used to determine the ability of some organisms to produce a neutral product, acetyl methyl carbinol (acetoin) from glucose fermentation. Glucose phosphate broth was prepared and dispensed into McCartney bottles and sterilized at 121℃ for 15 min, a loopful of 24 h old broth culture of the isolates was inoculated into the medium and then incubated at 37℃ for 48-72 h. Then 1 ml of 6% alpha-naphthol solution and 1 ml of 40% potassium hydroxide was added. Development of red coloration within 5 min constituted a positive reaction for voges proskauer test.

Citrate test: Simmon citrate agar (5g) was dissolved into 150ml of distilled water and was homogenized, 5 ml was pipetted into each test-tube and cork with aluminum foil paper. After which it was autoclave at 1210C for 15 min. Then it could set in a slant position and allowed to solidify. The organisms were stabbed using sterile inoculating loop, incubation was done at 37℃ for 2-3 days. After incubation color change from green to blue indicated positive results [12].

Sugar fermentation test: The ability of microorganisms to metabolize a variety of sugar as carbon source has been used to characterize these organisms and this depends on the type of enzyme produced by the organisms. Glucose, galactose, maltose, lactose, sucrose, xylose, dextrose, fructose and mannitol were used for this fermentation test. 1g of each sugar was weighed into different conical flask and labeled accordingly into each flask, peptone was added, and all were dissolved in 250 ml with distilled water. 0.01g of phenol red was added as indicator and 9ml each of the sugar solution was dispensed into different test tubes with Durham's tubes inverted into each test tube, the mouths of the tubes were plugged with cotton wool and aluminium foil, labeled appropriately and sterilization was done for 10 min at 121℃. After cooling, the tubes were inoculated with a loopful of isolates and incubated for a minimum of 37℃ for 72 h. Acid production was showed by a change in color of the medium from red to yellow and gas production was indicated by the displacement of air in the Durham tube (carbon dioxide).

Starch hydrolysis: This test was performed to test the utilization of starch by bacteria producing the enzyme amylase. Sterile starch agar medium was poured on a sterile petri dish plates and were allowed to solidify. The test organism was streaked on the plate and incubated for 48 h at 37℃. The plates were flooded with gram iodine and excess iodine was drained off. Plate were examined for clear zone around the line of streak for each organism.

Indole test: This was done to determine the ability of the organism to convert tryptophanto indole. Tryptophan broth was

prepared and dispensed into test tube and sterilized at 121°C for 15 min, a loopful of 24 h old broth culture of the isolate was inoculated into the medium and then incubated at 37°C for 24-28 h. However, 0.5 ml of kovac's reagent was added to the culture. Development of pink colored ring after addition of kovac's reagent indicated a positive result and no color change indicated a negative result.

Preparation of Seed Extract (*Moringa oleifera* and *Tamarindus indica* seeds)

The seeds were dried, shelled and blended. Five grams of the seed powder were weighed. 10ml distilled water was added, mixed and filtered. The filtrate was topped up to 100ml.

Jar test: Jar test is a laboratory procedure that stimulates coagulation/flocculation with deferring chemical dose. 500 ml raw water was poured into 4 beakers and placed under a multiple stirrer. The prepared seed extract was added at concentrations of 10, 20,30 and 40ml. This procedure was repeated for alum in other beakers. The set up was mixed thoroughly at a speed of 200 rpm for 5 minutes to enable total dispersal of coagulant and 30 rpm for 15 minutes to aid in effective flocculation of colloidal particles. After thorough mixing, the beakers were removed and placed on a work bench for an hour to settle [13].

Test for pH: 50ml volume of each water sample was poured into a beaker and electrode of already standardized pH meter was inserted which show the pH value of each water samples.

Test for Total Dissolve Solid (TDS): 50 ml of the water sample was poured into a beaker and already standardized TDS meter was inserted which show the value of the water sample.

Test for turbidity: This is the cloudiness or transparency of water, it is measure using "turbidimeter" stand 5, code 48 and the unit is "NTU" (Nephrelometeric turbidity unit), the standard is 5 and code is 48. Plung in the turbidimeter and allow to warm for 15 min. Zero it is using distilled water (10 ml). After stability adjusted the turbidimetre to zero. Then 10 ml of the water sample was poured into a small transparent bottle and inserted into the turbidimeter, allowed the value to stabilized and recorded.

Secondary metabolite screening (Phytochemical)

Qualitative Method of Analyses (*Moringa oleifera* and *Tamarindus indica* seeds): Plant filtrate were prepared by boiling 20 g of the fresh plant in distilled water. The solution was filtered through a vacuum pump. The filtrate was used for the phytochemical screening for flavonoids, tannins, saponins, alkaloids, reducing sugars, anthraquinones and antho cyanosides.

A. Test for Alkaloids

About 0.2g were warmed with 2% of H_2SO_4 for two minutes, it was filtered and few drops of Dragendoff's reagent were added. Orange red precipitate indicated the present of Alkaloids [14].

B. Test for Tannins

One milliliter of the filtrate was mixed with 2m1 of FeC1, A dark green color indicated a positive test for the tannins [14].

C. Test for Saponins

One milliliter of the plant filtrate were diluted with 2 ml of distilled water; the mixture was vigorously shaken and left to stand for 10min during which time, the development of foam on the surface of the mixture lasting for more than 10mm, indicated the presence of saponins [15,16].

D. Test for Anthraquinones

One milliliter of the plant filtrate was shaken with 10ml of benzene; the mixture was filtered and 5 ml of 10 % (v/v) ammonia were added, it was then shaken and observed. A pinkish solution indicated a positive test. Onwukaeme et al. [17].

E. Test for Anthocyanosides

One milliliter of the plant filtrate was mixed with 5 m1 of dilute HCI; a pale pink color indicated the positive test.

F. Test for Flavonoids

One milliliter of plant filtrate was mixed with 2 m1 of 10% lead acetate; a brownish precipitate indicated a positive test for the phenolic flavonoids. While for flavonoids, I m1 of the plant filtrate were mixed with 2m1 of dilute NaOH; a golden yellow color indicated the presence of flavonoids [14].

G. Test for Reducing Sugars

One milliliter of the plant filtrate was mixed with Fehling A and Fehling B separately; a brown color with Fehling B and a green color with Fehling A indicated the presence of reducing sugars [16].

H. Test for Cardiac glucosides

Legal test and the killer-kiliani was adopted, 0.5g of the extract were added to 2ml of acetic anhydrate plus H_2S0_4 [17].

Quantitative method of analyses of (*Moringa oleifera* and *Tamarindus indica* seeds)

a. Saponins

About 20g each of dried plant samples were grounded and, poured into a conical flask after which 100 ml of 20 % aqueous ethanol were added. The mixture was heated using a hot water bath at about 55 ℃ for 4hours with continuous stirring, after which the mixture was filtered and the residue was re-extracted with a further 200 ml of 20% ethanol. The combined extracts were reduced to 40 ml over a water bath at about 90°C. The concentrate was transferred into a 250 ml separatory funnel and 20 ml of diethyl ether was added and then shaken vigorously. The aqueous layer was recovered while the ether layer was discarded. The purification process was repeated three times. 60 rnl of n-butanol was added.

The combined n-butanol extracts were washed twice with 10 m1 of 5% aqueous sodium chloride. The remaining solution were heated in a water bath. After evaporation, the samples were dried in the oven to a constant weight; the saponin content was calculated as percentage of the starting material

b. Flavonoids

About 10g of the plant sample were extracted repeatedly with 100ml of 80% aqueous methanol, at room temperature. The whole solution was filtered through Whatman filter paper No 42. The filtrate was later transferred into crucible and evaporated into dryness over a water bath; the dry content was weighed to a constant weight.

c. Cardiac glucosides

Legal test and the killer-kiliani was adopted, 0.5g of the extract were added to 2ml of acetic anhydrate plus H_2S0_4.

d. Tannins

About 500 mg of the plant sample were weighed into a 50 ml plastic bottle. 50 ml of distilled water was added and shaken for 1 hour on a mechanical shaker. This was filtered into a 50 ml volumetric flask and made up to the marked level. Then, 5 ml of the filtrate was transferred into a test tube and mixed with 2 ml of 0.1 M FeCl in 0.1 M HCL and 0.008 M potassium ferrocyanide. The absorbance was measured at 120 nm within 10 minutes. The tannins content was calculated using a standard curve of extract.

e. Alkaloids

Five grams of the plant sample were weighed into a 250 ml beaker and 200ml of 10% acetic acid in ethanol was then added, the reaction mixture was covered and allowed to stand for 4 hours. This was filtered and the extract was concentrated on a water bath to one-quarter of the original volume. Concentrated ammonium hydroxide was added dropwise to the extract until the precipitation is complete. The whole solution was allowed to settle, and the precipitate was collected, washed with dilute ammonium hydroxide and then filtered; the residue being the alkaloid, was dried and weighed to a constant mass.

f. Phlobatannins

About 0.5grams of each plant extracts were dissolved in distilled water and filtered. The filtrate was boiled in 2% HCl, red precipitate shows the present of phlobatannins [18].

Results

Microorganisms of various groups were isolated from different well water sample in Akoko environments and Ado-Ekiti. The microbial assessment of the well water samples before treatment indicated that the water sample has contamination of both Gram positive and Gram-negative organisms. Seventeen bacterial species were isolated. Among the bacterial isolated and identified were Bacillus pumilus, Klebsiellapneumoniae, Enterobacteraerogenes, Alcaligenesfaecalis, Pseudomonas alcaligenes, Azotobacterchroococcum, Poracoccusdenitrificans. Table 1 showed the physical properties of the water samples while Table 2 showed th ecultural, physiological characteristics and biochemical reactions of isolated bacterial organisms. Table 3 depicted the microbial load of water samples before treatments. Physio chemical analysis of the untreated water sample is depicted in Figures 1-3. Microbial load of water sample after treatment with Moringa, Tamarindus and Alum at 0.2ml and 0.5ml concentration Figure 4 and 5. The physiochemical analysis of the water sample treatment using Tamarindus extract at 10mg/l, 20mg/l, 30mg/l and 40mg/l is showed in Figures 6, 7. Physiochemical analysis of the water sample treated with Moringa extract at different concentration are depicted in Figure 8, 9). Figures 10 & 11 showed the physiochemical analysis of the water sample treated with Alum at various concentration. Table 4 showed the qualitative analysis of secondary metabolites of *Moringa oleifera* and *Tamarindus indica* seed extracts. Quantitative analysis of secondary metabolites of *Moringa oleifera* and *Tamarindus indica* methanol, ethanol and ethyl acetate extracts are depicted in Table 5-7 respectively.

Figure 1: *Moringa oleifera* tree (Source: Kumar, 2012).

Figure 2: *Tamarindus indica* tree (Source: Camille, 2007).

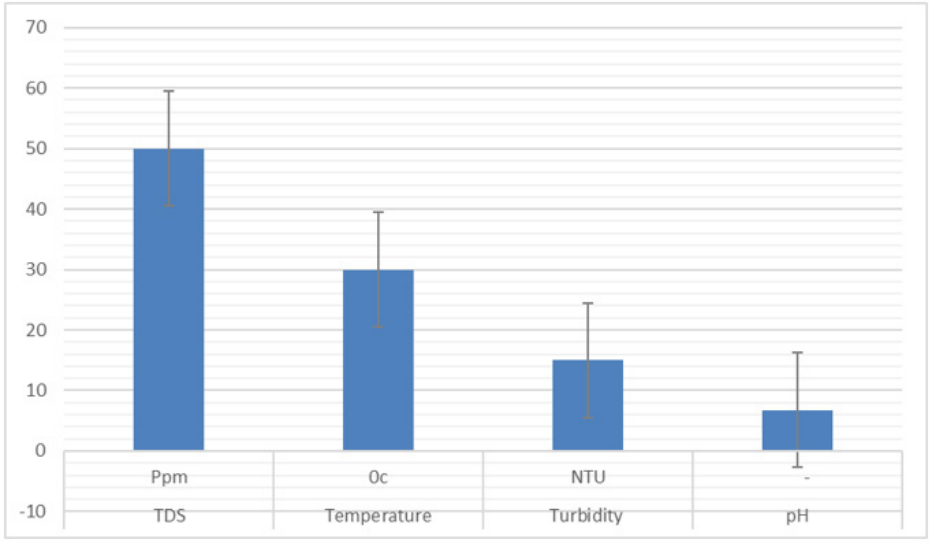

Figure 3: Physiochemical Analysis of untreated water sample.

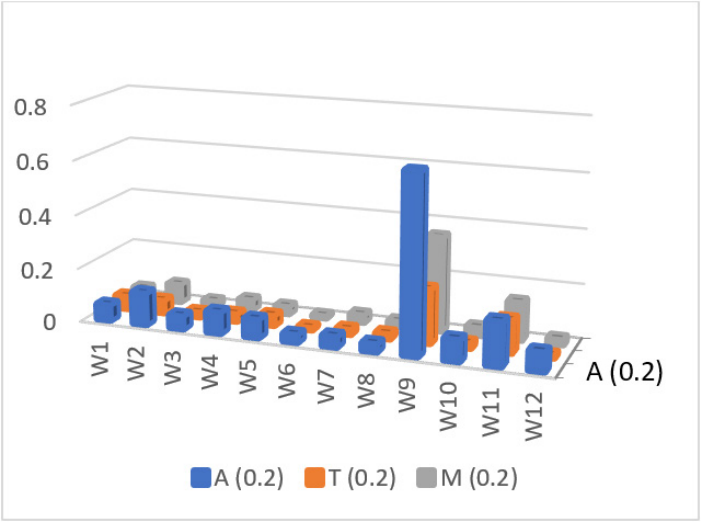

Figure 4: Microbial load of water sample after treatment with *Moringa oleifera*(M) and *Tamarindusindica*(T) seeds and Alum (A) at 0.2ml concentration.

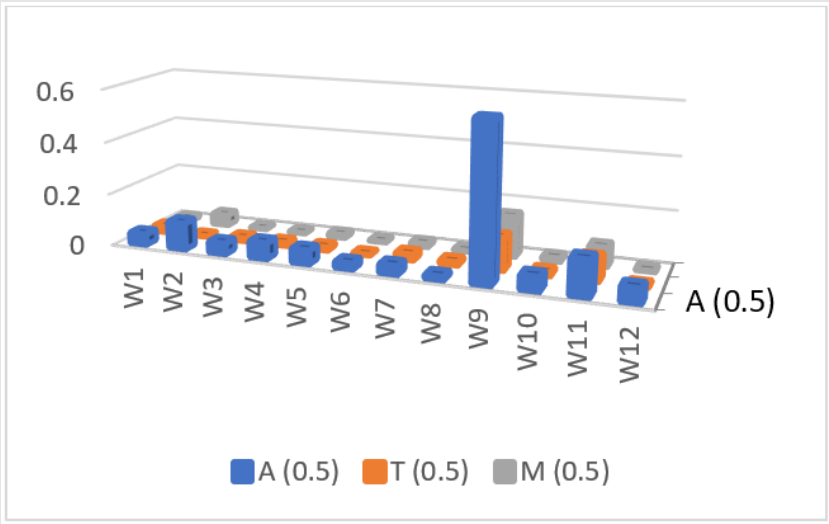

Figure 5: Microbial load of water sample after treatment with *Moringa oleifera*(M) *andTamarindusindica*(T) seeds and Alum (A) at 0.5ml concentration.

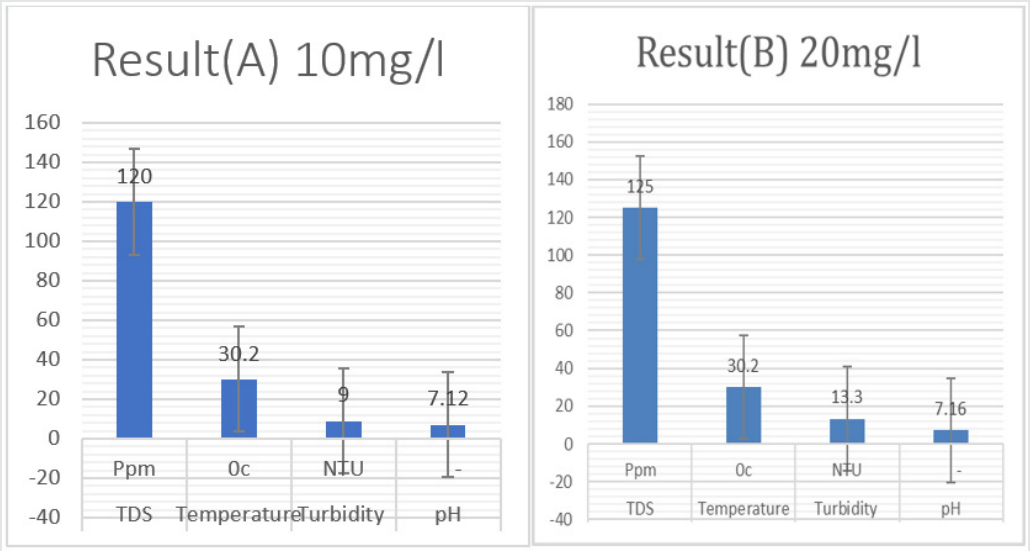

Figure 6: Physiochemical analysis of the water sample treatment using *Tamarindusindica* seeds extract at 10mg/l and 20mg/l.

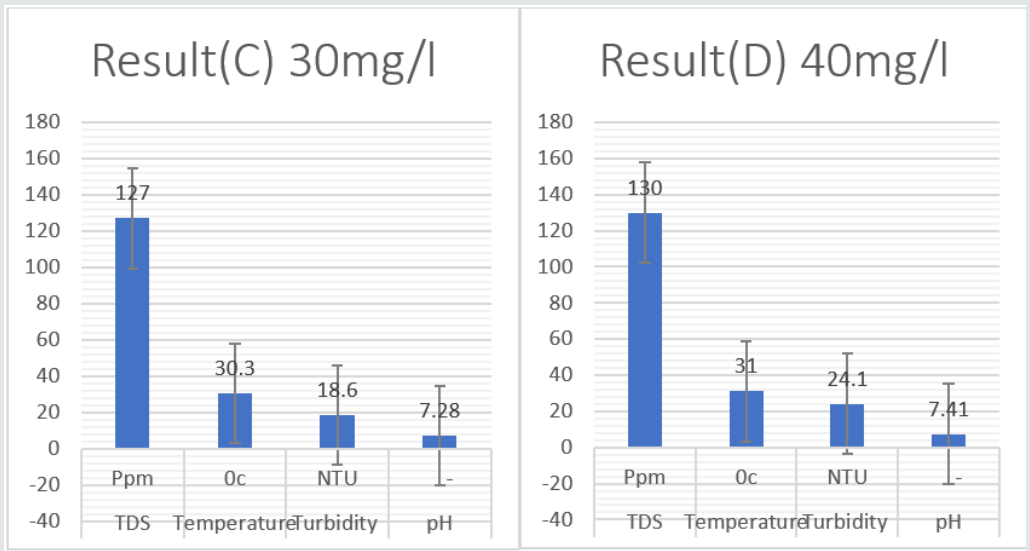

Figure 7: Physiochemical analysis of the water sample treatment using *Tamarindusindica* seeds extract at 30mg/l and 40mg/l

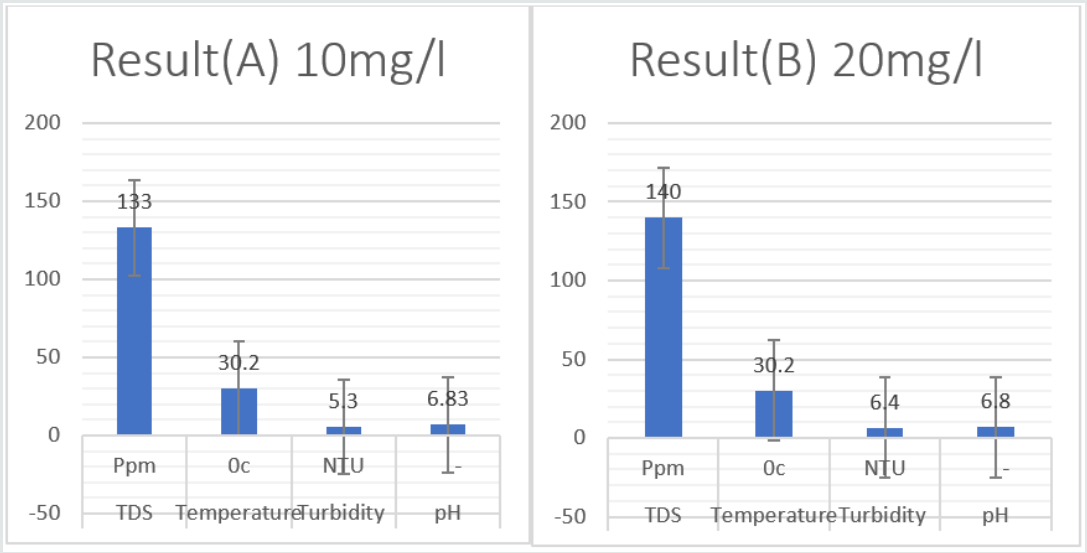

Figure 8: Physiochemical analysis of the water sample treatment with *Moringa oleifera* extract at 10mg/l and 20mg/l.

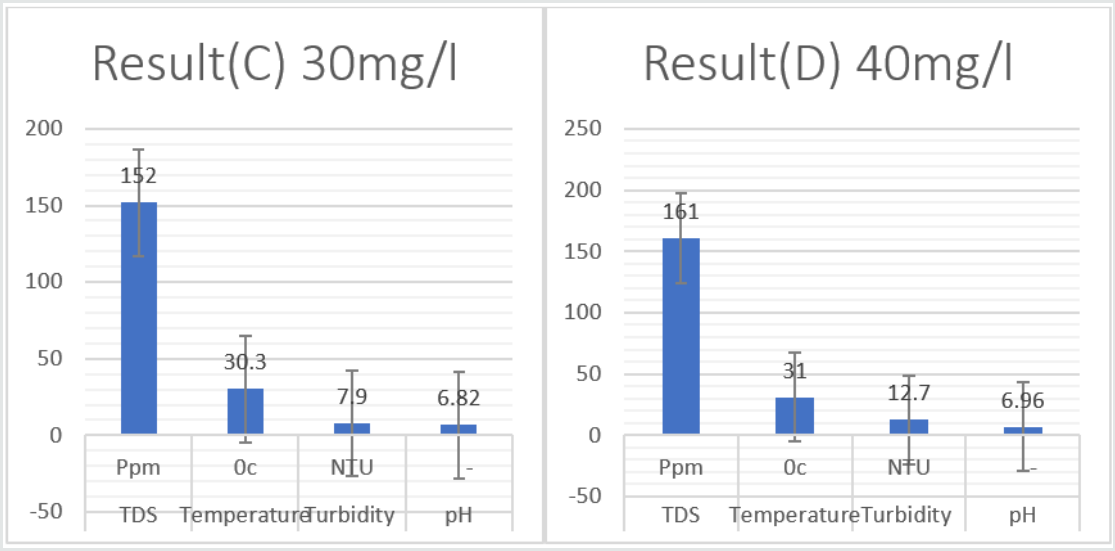

Figure 9: Physiochemical analysis of the water sample treatment using *Moringa oleifera* extract at 30mg/l and 40mg/l.

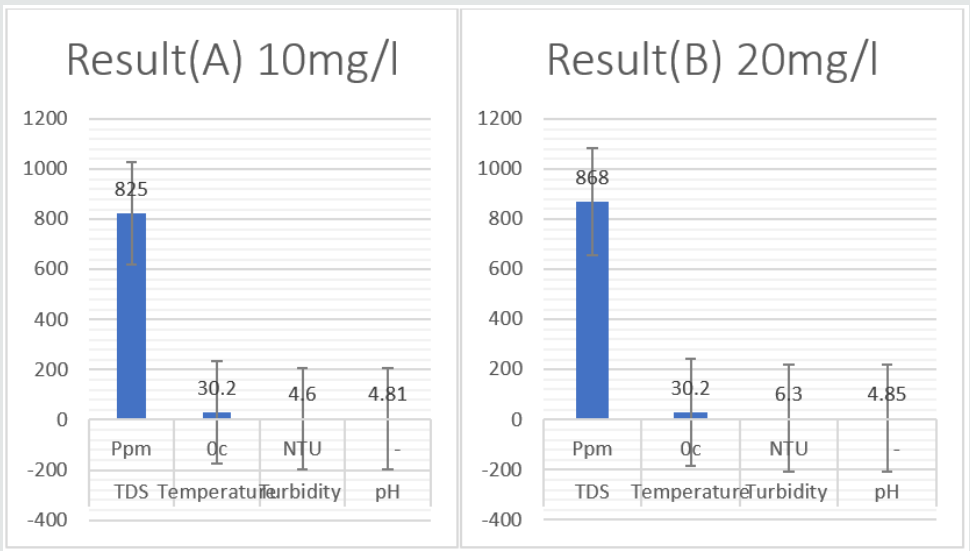

Figure 10: Physiochemical analysis of the water sample treatment using Alum at 10mg/l and 20mg/l.

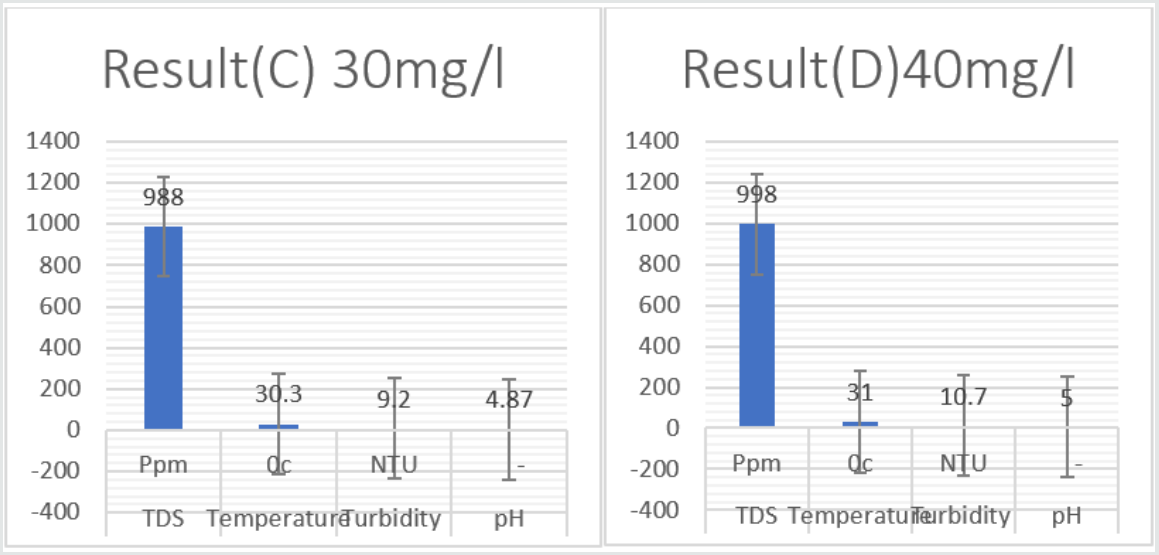

Figure 11: Physiochemical analysis of the water sample treatment using Alum at 30mg/l and 40mg/l.

Table 1: The physical properties of well water samples at each location.

Samples	Colour	Odour	Taste	Presence of particles	pH
Moferere(w1)	Colourless	Odourless	Tasteless	None	7.7
Araromi(w2)	Colourless	Odourless	Tasteless	Particles	7.6
Ereguru(w3)	Colourless	Odourless	Tasteless	Particles	7.5
Okeoriomi(w4)	Colourless	Odourless	Tasteless	None	6.3
Oke bola(w5)	Colourless	Odourless	Tasteless	None	6
Ajilosun(w6)	Colourless	Odourless	Tasteless	Particles	6.3
Ugbe(w7)	Colourless	Odourless	Tasteless	Particles	6.2
Ayegunle(w8)	Colourless	Odourless	Tasteless	None	6.3
Oka(w9)	Colourless	Odourless	Tasteless	Particles	6.4
Iwaro(w10)	Colourless	Odourless	Tasteless	None	6.3
Ikare(w11)	Colourless	Odourless	Tasteless	None	6.4
Akungba(w12)	Colourless	Odourless	Tasteless	Particles	6.4

Table 2: Cultural, Physiological Characteristics and Biochemical Reactions of Isolated Bacteria Organisms.

Colour	Cream	Cream	Pink	Cream	White	Cream	Cream	Cream	Cream	Cream	Cream	Cream
Surface	Smooth	Smooth	Smooth	Smooth	Smooth	Smooth	Smooth	Smooth	Smooth	Smooth	Smooth	Smooth
Edge	Circular	Circular	Rhizoid	Circular	Circular	Circular	Circular	Circular	Circular	Circular	Circular	Circular
Elevation	Flat	Flat	Flat	Flat	Flat	Flat	Flat	Flat	Flat	Flat	Flat	Flat
Shape	Rod	Rod	Rod	Rod	Rod	Rod	Rod	Rod	Rod	cocci	cocci	cocci
Gram Stain	+	-	-	-	-	-	-	-	+	+	+	+
Starch Hydrolysis	+	+	+	+	+	+	+	+	+	+	+	+
Catalase	+	+	+	+	+	+	+	+	-	+	+	+
Indole	-	-	-	-	-	-	-	-	-	-	-	-
Citrate	+	+	+	+	-	-	+	+	+	+	+	+
Methyl Red	-	-	-	-	-	-	-	-	-	-	-	-
VogesProskauer	-	+	+	-	-	-	-	+	-	-	-	-
Fructose	A	A	A	Ag	A	Ag	G	Ag	A	Ag	A	A
Sucrose	Ag	Ag	A	Ag	A	Ag	Ag	-	A	-	Ag	Ag
Lactose	Ag	Ag	A	A	Ag	A	A	Ag	A	A	Ag	-

Mannitol	A	A	A	A	A	A	A	Ag	A	A	A	A
Dextrose	A	A	A	A	A	A	A	A	A	A	Ag	A
Glucose	-	Ag	Ag	A	G	-	A	-	-	G	-	-
Galactose	G	G	-	-	-	-	Ag	-	-	-	-	-
Xylose	-	-	-	G	-	G	G	Ag	-	G	A	A
Maltose	-	A	A	A	A	A	A	A	A	A	Ag	Ag

Table 3: Microbial load of water sample before treatment.

Water sample	Bacteria load
W1	0.06×10^2
W2	0.14×10^2
W3	0.05×10^2
W4	0.08×10^2
W5	0.07×10^2
W6	0.02×10^2
W7	0.03×10^2
W8	0.04×10^2
W9	0.75×10^2
W10	0.05×10^2
W11	0.20×10^2
W12	0.08×10^2

Table 4: Qualitative Analysis of Secondary Metabolites of *Moringa oleifera* and *Tamarindus indica* extracts.

Sample	Alkaloid	Glycoside	Steroid	Anthraquine	Phenol	Tannins	Saponin	Flavonoid	Pyrrolizidine alkaloid	Reducing sugar	Terpenoid	Volatile oil	Cardiac glycosides
Tamaride sindica	+ ve	+ ve	+ ve	+ ve	+ ve	+ ve	+ ve	+ ve	+ ve	+ ve	+ ve	+ ve	+ ve
Moringa oleifera	-ve	+ ve	+ ve	- ve	+ ve	+ ve	+ ve	+ ve	+ ve	+ ve	+ ve	- ve	+ ve

Table 5: Quantitative Analysis of Secondary Metabolites of *Moringa oleifera* and *Tamarindus indica* methanol extracts

Sample	Alkaloid	Glycoside	Steroid	Anthraquine	Phenol	Tannins	Saponin	Flavonoid	Pyrrolizidine alkaloid	Reducing sugar	Terpenoid	Volatile oil	Cardiac glycosides
Tamarinde sindica	1.23	1.25	4.25	4.31	4.36	4.37	4.12	3	2.9	1.23	1.25	4.25	4.31
Moringao leifera	2.2	2.1	2.32	2.37	2.3	2.25	4.25	2.6	2.1	2.2	ND	2.32	2.37

Table 6: Quantitative Analysis of Secondary Metabolites of *Moringa oleifera* and *Tamarindus indica* ethanol extracts

Sample	Alkaloid	Glycoside	Steroid	Anthraquine	Phenol	Tannins	Saponin	Flavonoid	Pyrrolizidine alkaloid	Reducing sugar	Terpenoid	Volatile oil	Cardiac glycosides
Tamarinde sindica	3.23	1.25	4.25	4.31	4.36	4.37	5.2	3.23	1.25	4.25	4.31	4.36	4.37
Moringao leifera	2.2	2.1	2.32	2.37	2.3	2.25	ND	2.2	2.1	2.32	2.37	ND	2.25

Table 7: Quantitative Analysis of Secondary Metabolites of *Moringa oleifera* and *Tamarindus indica* ethyl acetate extracts

Sample	Alkaloid	Glycoside	Steroid	Anthraquine	Phenol	Tannins	Saponin	Flavonoid	Pyrrolizidine alkaloid	Reducing sugar	Terpenoid	Volatile oil	Cardiac glycosides
Tamarinde sindica	10	16.19	1.49	2.08	5.07	5.75	7.23	10	16.19	1.49	2.08	5.07	5.75
Moringao leifera	9.82	4.77	9.49	4.21	6.1	6.53	4.78	9.82	4.77	9.49	4.21	ND	6.53

Discussion

All the water sample collected for this study were contaminated with bacteria. However, contamination of the water samples differs from one sample to the other and was present in different proportions. Some of the bacterial organisms isolated have been implicated in water related diseases. The presence of Bacillus species in the well water sample could be as a result of contamination from poor handling by individual during fetching of water. Bacillus sp produce enterotoxin which could be deadly when ingested into the body. The presence of Alcaligenes faecalis could be as a result of human or animal fecal contamination. Presence of these bacteria in water may be unnoticed even in transparent water and the presence of these microorganisms may pose a potential risk to consumers. Even the consumption of such contaminated water may facilitate the widespread of infectious and can ultimately lead to outbreak of epidemic. The physiochemical properties of the water samples which serves as drinking water for some of the inhabitants of the studied area indicated that its colorless, odorless, tasteless and some are devoid of presence of particle while in some others there are presence of particles and after treatment the pH range between 6.80-7.41, which is within the standard of 6.5-8.5 as stipulated by WHO as criteria for drinking water. This also conforms to pH range reported by other authors [19-23].

The pH of most natural water ranges from 6.5-8.5 while deviation from the neutral 7.0 is as a result of the carbon dioxide/ bicarbonate/carbonate equilibrium. The pH of water is very important; fluctuation in optimum pH ranges may lead to an increase or decrease in the toxicity of poison in water. Poverty and ignorance prompt some people in drinking well water, meanwhile drinking of well water is not a crime but the way they are handle cause regular contaminations from environment, humans and animals. Such waters are delicate for human consumption and if it must be considered a good source of drinking water by the people, treatment and good hygiene practice must be put in place. The results obtained for the microbial analysis of the water samples after treatment with *Moringa oleifera* and *Tamarindus indica* seed solution at different concentrations indicated that the microbial load in the water sample reduced drastically and the results obtained from the microbial analysis of the water treatment with alum solution suggested that the alum do not have significant effect on microbial concentration in water.

Conclusion

From the study, the coagulative efficiency of using *Moringa oleifera* and *Tamarindus indica* seed extract in raw water treatment is 95%, when compared with alum commonly used in conventional water treatment. But in terms of availability, *Moringa oleifera* seed and *Tamarindus indica* extract is considered a better alternative because of high cost and non-biodegradabiltiy of the organic alum. *Moringa oleifera* and *Tamarindus indica* has been compared to alum in its effectiveness at reducing turbidity in unpurified or raw water, but with a major advantage, because it can be produced locally, the effectiveness of the seeds may vary from one raw water to another.

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